discharge, but also in large measure to an alternate process of exhaustion and restoration of excitability on the part of the responding tissues—the ganglionic period coinciding with that during which the process of restoration lasts, and the ganglionic discharge being thus always thrown in at the moment when the excitability of the responding tissues is at its climax.

Light has been found to stimulate the lithocysts of covered-eyed Medusæ into increased activity, thus proving that these organs, like the marginal bodies of the naked-eyed Medusæ, are rudimentary organs of vision.

The polypite of *Aurelia aurita* has been proved to execute movements of localization of stimuli, somewhat similar to those which the author has already described as being performed by the polypite of *Tiaropsis indicans.*

Alternating the direction of the constant current in the muscular tissues of the Medusæ has the effect of maintaining the make and break stimulations at their maximum value; but the value of these stimulations rapidly declines if they are successively repeated with the current passing in the same direction.

In the sub-umbrella of the Medusæ waves of nervous excitation are sometimes able to pass when waves of muscular contraction have become blocked by the severity of overlapping sections.

Exhaustion of the sub-umbrella tissues—especially in narrow connecting isthmuses of tissue—may have the effect of blocking the passage of contractile waves.

Lithocysts have been proved sometimes to exert their ganglionic influence at comparatively great distances from their own seats—contractile waves, originating at points in the sub-umbrella tissue remote from a lithocyst, and ceasing to originate at that point when the lithocyst is removed. A nervous connexion of this kind may be maintained between a lithocyst and the point at which the waves of contraction originate even after severe forms of section have been interposed between the lithocyst and that point.

When the sub-umbrella tissue of *Aurelia* is cut throughout its whole diameter, the incision will again heal up, sufficiently to restore physiological continuity, in from four to eight hours.

January 23, 1879.

W. SPOTTISWOODE, M.A., D.C.L., President, in the Chair.

The Presents received were laid on the table, and thanks ordered for them.

The following Papers were read :—

I. "Researches on Chemical Equivalence. Part I. Sodic and Potassic Sulphates." By EDMUND J. MILLS, D.Sc., F.R.S., "Young" Professor of Technical Chemistry in Anderson's College, Glasgow, and T. U. WALTON, B.Sc. Received October 16, 1878.

The conception of a chemical equivalent as employed in these researches corresponds to a definition first given* by one of us, viz., that the chemical equivalent of a body is that weight of it which does the unit of work. We do not therefore use the term in its ordinary sense; as, for example, when it is said that H is "equivalent" to Cl, Na, &c.

The following experiments were arranged with the view of determining the effect of potassic and sodic sulphates on the rate of formation of ammonia, when nascent hydrogen is made to act on potassic nitrate. Judging from their behaviour in other cases, it was expected that in this instance, also, their action would be one of retardation. Experiment, however, has proved the reverse, on the whole, to be true.

The extremely delicate nature of the reaction, which is liable to be spoiled by the accidental falling in of a single speck of dust, or by slight variation of temperature, or unequal exposure of the different solutions to light, rendered the attempt to measure the effect a matter of peculiar difficulty.

At first, common sheet zinc, thoroughly cleansed from grease, was placed in a solution of potassic nitrate and hydrate, and the amount of ammonia formed during periods varying from twenty-four hours to one week was measured. But the results were very irregular and unsatisfactory. Galvanic couples seemed to be established at certain points on the surface of the zinc, probably due to the presence of iron or lead as impurities. Thin zinc foil was next tried, but with little better result; neither were any alterations in the shape or disposition of the foil attended with success. Fresh experiments were also undertaken with sodium amalgam instead of zinc and potassic nitrate; but the action, though rather more uniform, was still very uncertain. It was found impossible to obtain a perfectly homogeneous solution of sodium in mercury, entirely free from sodic oxide and hydrate; and this seriously impaired the accuracy of measuring out the amalgam.

The only plan which was found to give results at all comparable with each other, was using zinc amalgam and potassic nitrate. The experiments were performed in wide-mouthed glass-stoppered bottles of cylindrical shape, having an internal diameter of 60 mm., and a total capacity of 315 cub. centims. Each bottle contained 1 grm.

* "Philosophical Magazine," [5], i, 14.

potassic nitrate, 1 grm. potassic hydrate (prepared from the sulphate by means of baryta water), and a quantity of anhydrous alkaline sulphate, varying from 0 to 1 grm.; the whole being dissolved in 150 cub. centims. of distilled water, very free from ammonia. The reagents had been carefully purified. 30 cub. centims. of amalgam, prepared by dissolving 10 grms. zinc in 10 kilogs. mercury, were then added, and the "system" was preserved from dust and light. After twenty hours, the amount of ammonia was estimated by Nessler's method. Traces of this substance were occasionally present in the solutions employed, and a corresponding correction had to be made. In every experiment, nine solutions were prepared at the same time—three free from sulphate, three containing sodic sulphate, and three potassic sulphate; and the mean of each three was taken as the true value for that particular experiment. Fifteen comparisons of each of nine solutions, arranged in this way, were made with different quantities of sulphate. The temperature was taken at the beginning, in the middle, and at the conclusion of the experiment; the temperature at night being registered by one of the automatic thermometers sold by Negretti and Zambra. Owing to the extreme delicacy of the reaction and the slight causes which suffice to interfere with it, the numbers obtained from single experiments are not sufficiently reliable to measure the precise amount of change caused by varying the quantity of alkaline sulphate. Every comparison, however, though made with a different weight of sulphate from that employed in the others, involved equal weights of potassic and of sodic sulphate; and hence the relative effect of those two bodies has been very clearly approximated to.

The following table gives a summary of the observations made:—

Grm. sulphate added.	Mean temp. C.	Grm. ammonia formed in the blank (150 c.c.).	Ratio.		
			Blank.	Experiment with sodic salt.	Experiment with potassic salt.
0·1	18·4	0·0000432	100	102·2	99·5
*0·1	14·6	0·0000135	100	99·1	88·8
0·2	13·4	0·0000424	100	100·1	103·2
0·3	16·4	0·0000459	100	79·3	79·5
0·3	14·1	0·0001200	100	103·9	102·0
0·4	15·6	0·0001350	100	105·4	109·5
*0·5	15·6	0·0000655	100	108·5	97·7
*0·5	16·3	0·0000493	100	110·1	96·6
0·6	18·4	0·0000391	100	99·5	105·1
0·6	22·6	0·0000445	100	109·7	107·8
0·7	17·1	0·0000431	100	104·8	104·8
0·8	15·2	0·0000670	100	113·8	113·2
0·9	15·4	0·0000679	100	107·1	113·4
*1·0	12·3	0·0000359	100	111·1	129·8
1·0	17·0	0·0000456	100	121·7	114·9

The ratio of the working effect of sodic to that of potassic sulphate, as calculated from the numbers given above, is 100·16 : 100, with a probable uncertainty of 1·3 per cent. This is the *mean* value, reckoned by the method of least squares, from the whole of the observations. The rejection of the four experiments marked with an asterisk, which differ somewhat widely from the rest, would give the ratio 99·53 : 100, with a probable uncertainty of 0·73 per cent.; while the probable error of a single observation would then be reduced from 5·02 to 2·4 per cent. [Owing to the number of determinations made, any error in the result is but very slightly affected by error in the ammonia estimation.]

The conclusions which we think may fairly be drawn from these numbers are:—

(1.) That sodic and potassic sulphates have a well-marked influence on the reaction to which we have referred;

(2.) That as more sulphate is added, the reaction is accelerated;

(3.) That equal weights of sodic and potassic sulphates have as nearly as possible the same working effect.

The last conclusion may be otherwise expressed thus:—

If we represent our equivalent of potassic sulphate by a number, then the equivalent of sodic sulphate is represented by the same number.

II. "Researches on Chemical Equivalence." Part II. Hydric Chloride and Sulphate. By Edmund J. Mills, D.Sc., F.R.S., and James Hogarth. Received December 4, 1878.

While carrying out our researches on lactin,* it struck us that use might be made of it to compare the dynamical equivalents of acid bodies. We accordingly selected hydric chloride and hydric sulphate for the measurements in question, and prepared solutions of these acids, containing respectively 73 grammes hydric chloride (2HCl), and 196 grammes hydric sulphate ($2H_2SO_4$) per litre. An experiment was first tried with 5 grammes lactin and 10 cub. centims. of the hydric chloride solution in a total volume of 70 cub. centims. At a temperature of 17° C. there was no change of rotation in twenty-four hours. In a second experiment a similar solution was raised for an hour to 40° C., and then for an hour to 60° C.; but without effect on the rotatory power. The temperature of 100° C. was finally adopted, the change at that point taking place at a rate admitting of accurate measurement. The method of experiment was as follows:—A measuring flask was made marked to contain 60 cub. centims.; in this were placed 50 cub. centims. of a 10 per cent. solution of lactin (*i.e.*, 5 grammes), the acid measured in, and the volume made up to

* *Post*, p. 273.